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Two new species of the genus *Neopanorpa* (Mecoptera: Panorpidae) from Yunnan, China

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Abstract: *Neopanorpa* van der Weele, 1909 is the second largest genus in the scorpionfly family Panorpidae, next to *Panorpa* Linnaeus, 1758, and is mostly endemic to the Oriental Region. Four Chinese-endemic species are currently recognized in the *N. brisi* group *sensu* Wang & Hua, 2021 (two in Yunnan). In this paper, two new species are described as new: *N. daguanensis* **sp. nov.** and *N. kinnara* **sp. nov.** These new discoveries enrich the known species number of the *N. brisi* group from two to four in Yunnan Province, and four to six in the entire group.

Keywords: Biodiversity, *Neopanorpa*, new species, scorpionflies, taxonomy

中国云南新蝎蛉属（长翅目：蝎蛉科）两新种之记述

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摘要：新蝎蛉属 *Neopanorpa* van der Weele, 1909 是蝎蛉科中仅次于蝎蛉属 *Panorpa* Linnaeus, 1758 的第二大属，主要分布于东洋区。目前，中国特有的布里斯种团 *N. brisi* group 中已知有四个物种（其中两个在云南有分布）。本文描述了两个新种：大关新蝎蛉 *N. daguanensis* **sp. nov.**和紧那罗新蝎蛉 *N. kinnara* **sp. nov.**。这些发现将云南省内布里斯种团的物种数量从 2 个提升为 4 个，整个种团的物种数量从 4 个增加至 6 个。

关键词：生物多样性，新蝎蛉属，新种，蝎蛉，分类学

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Introduction

Panorpidae are the largest extant family within the insect order Mecoptera, and distributed mainly across the Holarctic and Oriental regions (Penny & Byers 1979; Bicha 2018; Wang & Hua 2019). Adults are commonly known as "scorpionflies" due to the enlarged and recurved male genitalia, which resemble the stinger of a scorpion (Byers & Thornhill 1983). Members of Panorpidae are currently classified into two subfamilies and 13 genera (Wang & Hua 2021, 2022; Willmann 2022, 2024). Among these genera, *Neopanorpa* van der Weele, 1909, which was originally described as a subgenus of *Panorpa* Linnaeus, 1758 and later elevated to full generic status by Esben-Petersen (1913), is the second-largest genus in Panorpidae, following *Panorpa* (Chandra 2004; Bicha 2015; Bicha *et al*. 2017; Wang & Hua 2017ab). It is mostly endemic to the Oriental Region, and is particularly abundant in southern China, India, the Indochinese Peninsula, and Indonesia (Wang & Hua 2022; Willmann 2022). Morphologically, members of this genus can be characterized by a greatly developed male notal organ, first anal vein (1A) ending proximal to the origin of Radial Sector (ORs) in forewings, hindwings lacking cubito-anal crossvein (cu-a), and less developed male salivary glands (Wang & Hua 2018, 2022). Biologically, they exhibit coercive mating behavior instead of providing nuptial gifts during copulation (Byers & Thornhill 1983; Zhong & Hua 2013, Wang & Hua 2018).

Notably, four Chinese-endemic species are currently recognized in the *N. brisi* group *sensu* Wang & Hua, 2021: *N. apicata* Navás, 1922, *N. brisi* (Navás, 1930), *N. fangxianga* Zhou & Zhou, 2007, and *N. pendula* Qian & Zhou, 2001. They are characterized by the following combination of morphological features: 1) Male tergum III (T3) with a small projection beneath notal organ; 2) male hypovalves broad and elongate, inner margins overlapping, forming a basal window; 3) parameres well-developed, mostly lamellate; 4) female medigynium with apodemes concealed (Navás 1922; Wang & Hua 2018, 2021, 2022).

In this paper, two new species of the *N. brisi* group are described from Yunnan, China. These new discoveries enrich the known species number of *N. brisi* group from two to four in Yunnan Province, and four to six in the entire group.

Material and methods

All the material examined in this study are deposited in the Biological Science Museum, Dali University (**BMDU**). Adult insects were caught with a sweeping net, preserved in 95% ethanol or pinned. Photographs were taken with a Nikon D850 digital camera in conjunction with a Nikkor AF-S Micro 105 mm f/2.8 lens (habitus), or a Canon R5 digital camera in conjunction with a Canon MP-E 65 mm f/2.8 1-5× macro lens (the other images). The female habitus in dorsal view (Figs 1B & 2B) were modified to omit the left antenna, wings and legs. All pictures were adjusted and grouped with Adobe Photoshop CC. The terminology and measurements follow Wang & Hua (2021).

The following acronyms are applied in the main text:

1A = First anal vein (and so forth for other anal vein)

A1 = First abdominal segment (and so forth for other segments)

AbL = Abdomen length

AtL = Antenna length

BL = Body length

FL = Forewing length

FM = Fork of Media

FW = Forewing width

HL = Hindwing length

HW = Hindwing width

ORs = Origin of Rs

S1 = First sternum (and so forth for other sterna)

Sc = Subcosta

T1 = First tergum (and so forth for other terga)

The following abbreviations are used in figures:

Ap = Apodeme of axis
Ax = Axis
BL = Basal lobe
DBr = Dorsal bridge of paramere
DV = Dorsal valve
Ep = Epandrium
EpL = Epandrial lobe
Gcx = Gonocoxites
Gs = Gonostylus
Hv = Hypovalve
LPr = Lateral process
MPr = Median process
NO = Notal organ
PA = Posterior arm
Pm = Paramere
PnO = Postnotal organ
StH = Stalk of hypandrium
StP = Stalk of paramere
VV = Ventral valve

Taxonomy

Order Mecoptera Packard, 1886 长翅目
Family Panorpidae Latreille, 1802 蝎蛉科
Subfamily Neopanorpinae Wang & Hua, 2021 新蝎蛉亚科
Genus *Neopanorpa* van der Weele, 1909 新蝎蛉属
***N. brisi* group *sensu* Wang & Hua, 2021 布里斯新蝎蛉种团**

***Neopanporpa daguanensis* sp. nov. 大关新蝎蛉**

https://zoobank.org/72072724-D031-456E-90C1-AFED181416C5
Fig. 1

Etymology. The new species is named after the type locality, Daguan County, Yunnan Province, China. Adjective.

Diagnosis. The new species is peculiar in this group for having well-developed wing markings in males (*vs.* more or less reduced in males). It is similar to *N. fangxianga* in general appearance, but differs from the latter by the following features: in males, 1) posterior margin of T3 with a short digitiform process on each side of notal organ; notal organ extending to approximately 2/3 of T4 (*vs.* no such processes; notal organ shorter and reaching nearly 1/3 of T4); 2) epandrium with arcuate apex (*vs.* emarginated); and in females, 3) subgenital plate with V-shaped emargination, and apodemes of medigynium indistinct (*vs.* truncate; apodemes greatly elongated).

Type material. Holotype ♂ (CN22Ndg001), **CHINA: Yunnan: Zhaotong City,** Daguan County, 27°44'49.56"N, 103°54'32.76"E, 1660 m, 25.VIII.2022, leg. Dan-Chen Zhu (BMDU); Paratypes 2♂10♀ (CN22Ndg002–013), same data (BMDU).

Measurements (mm). *Male* (holotype and paratypes, n = 3): AtL 13.3–14.2, AbL 11.2–12.9, BL 14.6–16.9, FL 14.1–15.4, FW 4.1–4.3, HL 12.6–13.1, HW 3.9–4.1; *Female* (paratypes, n = 10): AtL 13.1–14.0, AbL 8.1–8.5, BL 12.1–12.6, FL 13.6–14.4, FW 3.9–4.2, HL 12.1–13.6, HW 3.7–4.1.

Description. *Male*. Head (Fig. 1A). Vertex, ocellar triangle and occiput shining black. Rostrum yellowish with pair of brown longitudinal stripes, maxillae and labial palps yellowish brown. Antennae blackish.

Thorax (Fig. 1A). Pronotum dark brown with two stout setae on each side of anterior margin. Meso- and metanotum mostly black with large unevenly brown spot on each side. Pleura and legs pale brown with apex of tibia and distal tarsomeres dark brown.

Wings (Fig. 1A). Narrow basally with rounded apex. Membrane subhyaline and tinged with brown; markings dark brown. Pterostigma dark brown; veins mostly brown with distal cross-veins whitish. Forewing with apical band emarginated in posterior portion; pterostigmal band well-developed, with basal branch broad and apical branch

narrow; basal band reduced to irregular spot. Sc extending to pterostigmal area; R_1 simple, Rs six-branched with R_2 trifurcated, R_{2a} bifurcated; 1A ending before origin of ORs; one cross-vein between 1A and 2A. Hindwings similar to forewings.

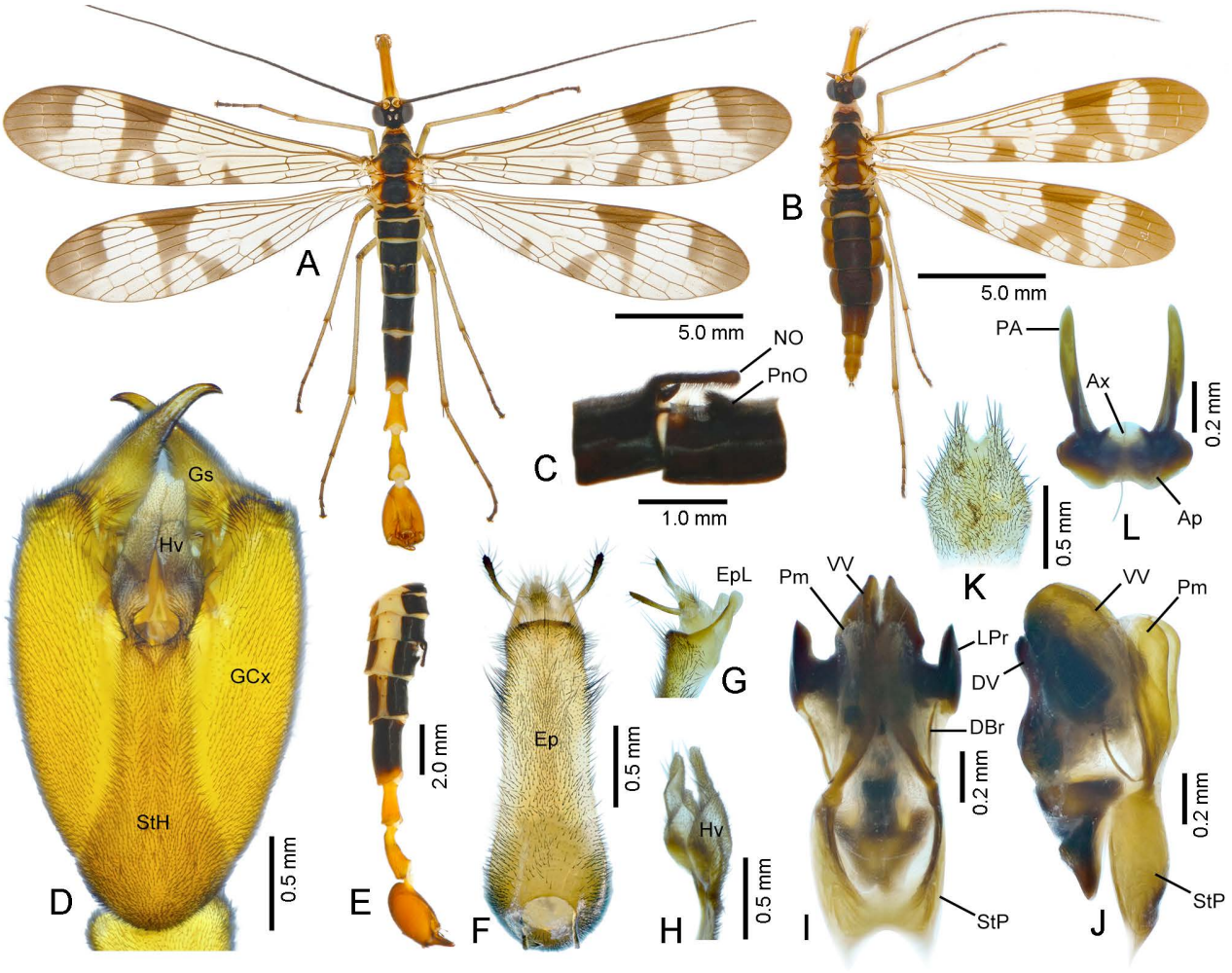

FIGURE 1. *Neopanorpa daguanensis* **sp. nov.**: **A, C–J** male **B, K & L** female **A & B** habitus, dorsal view **C** T3 and T4, left-lateral view **D** genital bulb,ventral view **E** abdomen, left-lateral view **F** epandrium, dorsal view **G** epandrial lobe, right-lateral view **H** hypovalve, right-lateral view **I & J** aedeagal complex, ventral and right-lateral views, respectively **K** subgenital plate, ventral view **L** medigynium, ventral view.

Abdomen (Fig. 1A, C & E). T1–T5 black, S1–S5 yellowish brown. T3 with notal organ rod-like, dorsally arched near base; apex slightly enlarged, reaching approximately 2/3 length of T4; acute process below notal organ; and short digitiform processes on each side of notal organ basally. Postnotal organ on T4 subacute, obliquely directed anterio-dorsally. A6 cylindrical, black with yellowish brown apex. A7 yellowish brown, approximately 2/3 as long as A6, slightly constricted at base; lateral sides of posterior dorsal margin strongly protruding postero-laterally. A8 similar to A7 but more curved basally.

Male genitalia (Fig. 1D, F–J). Genital bulb yellowish brown, stout, oval. Epandrium elongate, epandrium with shallowly arcuate apex; epandrial lobes greatly elongated, broad basally and tapering towards rounded apex. Hypandrium with long basal stalk approximately twice as long as pair of short, leaf-like hypovalves; hypovalves overlapping mesally and forming subcircular window at base (Fig. 1D), and greatly curled along lateral margin (Fig. 1H). Gonocoxites broad, with slightly darkened apex; gonostyli approximately half as long as gonocoxites. Parameres broad and leaf-like, with rounded apices; dorsal bridge slender. Stalk of parameres broad and fused

basally. Ventral valves broad and laterally flattened. Lateral processes spear-like and strongly sclerotized.

Female. Similar to males in general appearance except for denser wing markings.

Female genitalia (Fig. 1K & L). Subgenital plate broadly triangular, with V-shaped terminal emargination, and long stout setae on distal half. Medigynium with main plate well-developed and strongly sclerotized; lateral margins with prominent earlobe-like projections extending beyond base of posterior arms laterally. Posterior arms elongate, approximately 2.5 times as long as main plate. Axis completely concealed within main plate.

Distribution. CHINA: Yunnan: Zhaotong (Daguan).

Neopanorpa kinnara sp. nov. 紧那罗新蝎蛉

https://zoobank.org/36B6211A-38EA-4A6C-B93A-1C4597AB9CB0

Figs 2 & 3

Etymology. The specific epithet, *kinnara*, refers to a mythical creature from Buddhist tradition, depicted as part human and part bird, and strongly associated with music and love. Treated here as a feminine noun in apposition.

Diagnosis. The new species is similar to *N. brisi* and *N. fangxianga* in general appearance and sexually dimorphic wing markings. It can be readily distinguished from *N. brisi* by the following characters: in males, 1) T3 with notal organ greatly elongate, extending to approximately 2/3 the length of T6 (*vs.* shorter, reaching nearly 2/3 the length of T4); 2) gonostyli with broad disc-shaped basal lobe (*vs.* basal lobe irregularly shaped, with a slender, hook-like basal protuberance); in females, 3) medigynium with greatly enlarged apodemes of axis (*vs.* less enlarged).

It can be differentiated from *N. fangxianga* by the following features: in males, 1) in wings, pterostigmal band nearly absent (*vs.* exist); 2) T3 with notal organ elongate, extending to approximately 2/3 the length of T6 (*vs.* short, reaching nearly 1/3 the length of T4); 3) epandrium apically truncate (*vs.* with arcuate emargination); in females, 4) subgenital plate broadly triangular, with V-shaped terminal emargination (*vs*. truncate at apex); and 5) medigynium with apodemes short and greatly enlarged (*vs.* slender).

It can also be differentiated from *N. apicata* by the projected inner margin of apical band in forewings (*vs.* not projected), and from *N. pendula* by the greatly elongated male notal organ and developed wing markings (*vs.* shorter than T3 and less developed markings).

Type material. Holotype ♂ (CN23Nkn001), **CHINA: Yunnan: Dali Bai Autonomous Prefecture:** Binchuan County, Jizu Mountain, 25°57'31.19"N, 100°24'2.15"E, 2300 m, 18.VII.2023, leg. Ji-Shen Wang & Liang-Jie Jia (BMDU). Paratypes: 3♂1♀ (CN23Nkn002–005), same data (BMDU); and Paratypes: 2♂2♀ (CN23Nkn006–009), Heqing County, Ma'er Mountain, 26°11'46.24"N, 100° 8'53.20"E, 2480 m, 7.VII.2023, leg. Ji-Shen Wang & Liang-Jie Jia (BMDU); and Paratypes: 7♂6♀ (CN23Nkn0010–0022), Eryuan County, Tianma Mountain, 26°3'0.11"N, 99°56'31.93"E, 2140 m, 30.VII.2023, leg. Ji-Shen Wang & Yu-Fei Li (BMDU).

Measurements (mm). *Male* (holotype and paratypes, n = 13): AtL 14.3–16.8, AbL 13.1–16.8, BL 18.1–22.1, FL 15.8–17.5, FW 4.2–4.3, HL 15.1–16.5, HW 4.0–4.1; *Female* (paratypes, n = 9): AtL 14.1–15.8, AbL 9.6–10.9, BL 14.2–15.2, FL 14.9–16.9, FW 3.4–3.8, HL 13.6–16.1, HW 3.2–3.6.

Description. ***Male.*** Head (Fig. 2A). Ocellar triangle and occiput black, large unevenly yellowish brown spot on each side of vertex. Rostrum brown with pair of dark brown longitudinal stripes, maxillae and labial palps yellowish brown with blackish apices. Antennae black with 46 flagellomeres.

Thorax (Fig. 2A). Pronotum black with three stout setae on each side of anterior margin. Meso- and metanotum mostly pale yellowish brown with broad black median stripe. Legs and pleura yellowish brown with apex of tibia and distal tarsomeres blackish.

Wings (Fig. 2A). Narrow basally with rounded apex. Membrane subhyaline and tinged with grayish brown; markings grayish brown. Pterostigma dark brown; veins mostly grayish brown with distal cross-veins whitish. Forewing with apical band broad, emarginated posteriorly and forming acute projection innerly. Pterostigmal band

reduced into few small spots. Sc extending to pterostigmal area; R_1 simple; Rs six-branched with R_2 trifurcated, R_{2a} bifurcated; 1A ending nearby before origin of ORs; one cross-vein between 1A and 2A. Hindwings similar to forewings with more reduced markings.

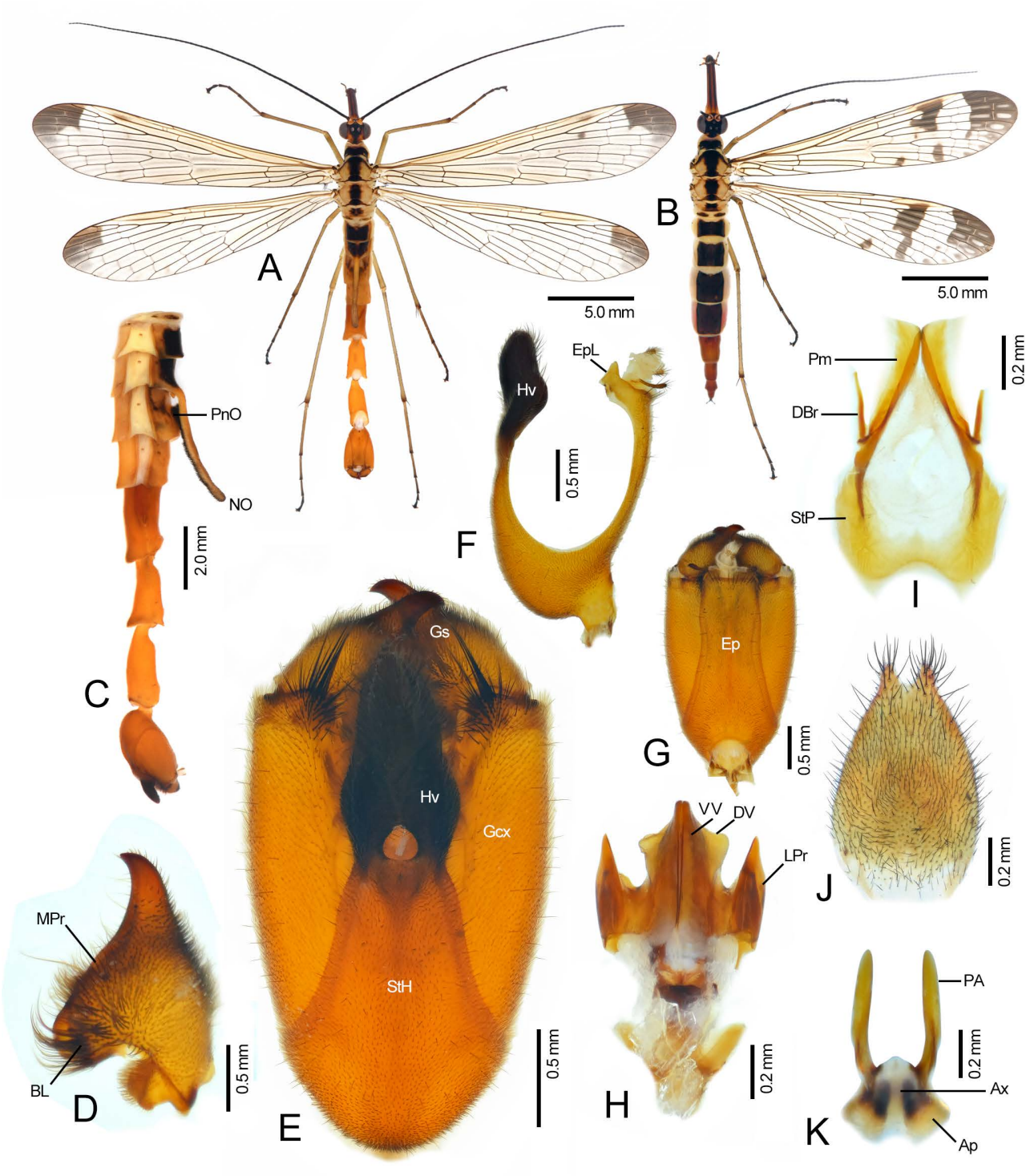

FIGURE 2. *Neopanorpa kinnara* **sp. nov.**: **A, C–I** male **B, J & K** female **A & B** habitus, dorsal view **C** abdomen, left-lateral view **D** right gonostylus, ventral view **E** genital bulb, ventral view **F** epandrium and hypandrium, right-lateral view **G** genital bulb, dorsal view **H & I** aedeagal complex, ventral view **J** subgenital plate, ventral view **K** medigynium, ventral view.

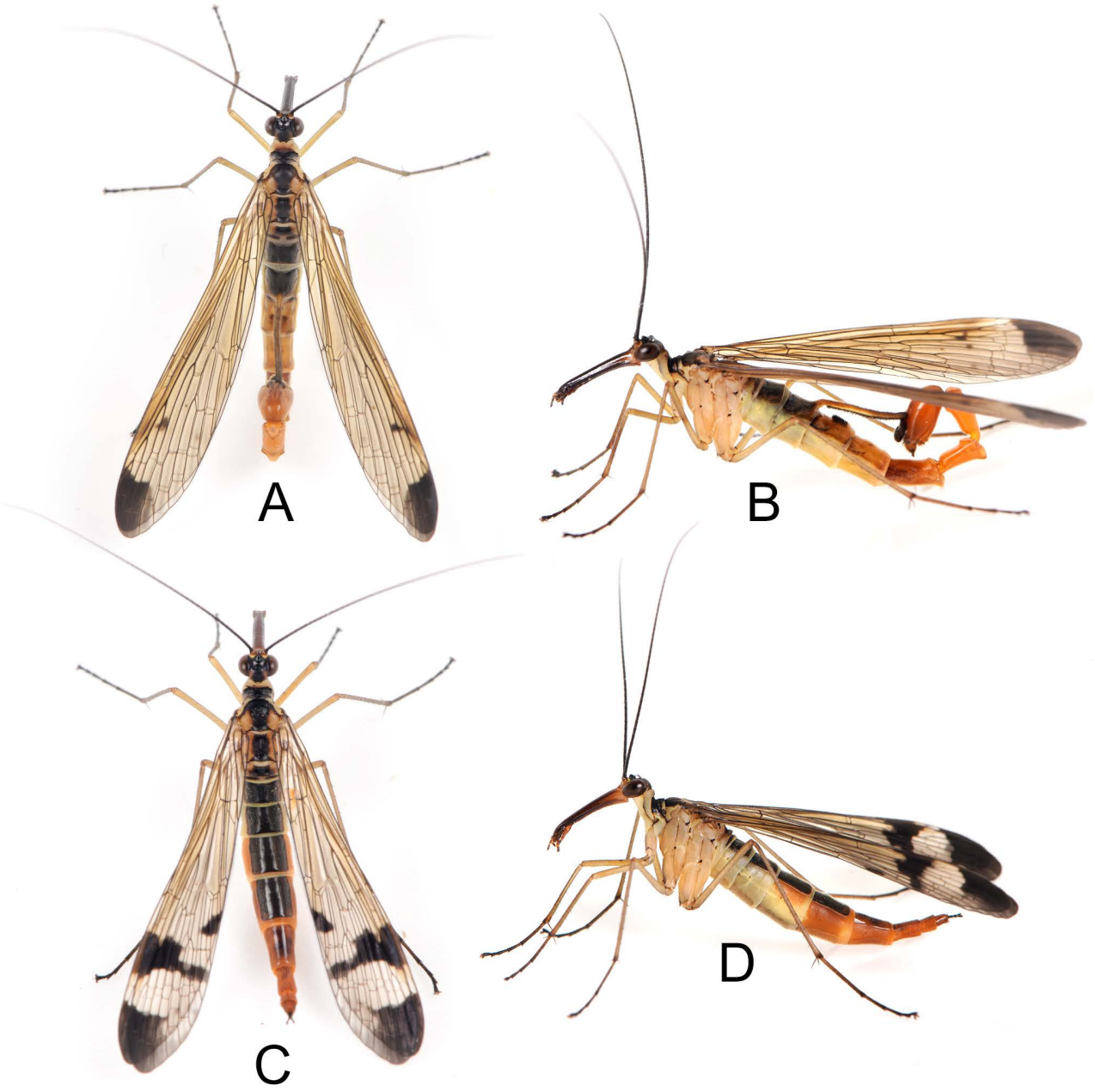

FIGURE 3. *Neopanorpa kinnara* **sp. nov.** (individuals from Ma'er Mountain): **A & B** male **C & D** female **A & C** dorsal view **B & D** lateral view.

Abdomen (Fig. 2A & C). T1–T3 black, T4–T5 unevenly yellowish brown, S1–S5 light yellowish brown. Notal organ greatly elongated with varied length, extending slightly beyond T4 or approximately 2/3 of T6; small pointed projection beneath notal organ. T4 with rounded postnotal organ. A6 yellowish brown, cylindrical, with posterior margin of dorsal side slightly concave. A7 yellowish brown, almost as long as A6, slightly constricted at base; broad U-shaped emargination at dorsal apex. A8 similar to A7 but more curved at base.

Male genitalia (Fig. 2D–I). Genital bulb yellowish brown, long oval. Epandrium broad and elongate, with entire apex; epandrial lobes well developed, strongly curved inward, with sharply pointed apices. Hypandrium with subtrapezoidal broad basal stalk and split into pair of slightly shorter hypovalves. Hypovalves black, overlapped mesally, and forming subcircular window basally (Fig. 2E). Apices of gonocoxites slightly darkened, with several

long black setae; gonostyli shorter than half-length of gonocoxites, with broad disc-shaped basal lobe. Parameres simple, blade-like and converging apically; dorsal bridge slender. Ventral valves greatly sclerotized along inner margin and slightly protruding laterally near midlength; dorsal valves short, subtriangular; lateral process broad and laterally flattened.

Female. Similar to males in general appearance, but with black T4–T5 and more developed pterostigmal and apical band (Fig. 2B).

Female genitalia (Fig. 2J & K). Subgenital plate broadly subtriangular, with V-shaped terminal emargination and long stout setae in distal portion. Medigynium with subtriangular main plate, well-developed and greatly sclerotized; posterior arms narrow, approximately twice as long as main plate, twisted near base, with slightly pointed apices; axis completely concealed in main plate with greatly enlarged apodemes.

Distribution. CHINA: Yunnan: Dali (Ma'er, Tianma, and Jizu Mountains)

Key to species of the *N. brisi* group

(Males of 5 spp., excluding *N. apicata* due to its poorly known morphology)

1. Posterior margin of T3 with a short digitiform process on each side of notal organ.....**2**

Posterior margin of T3 lacking such processes **4**

2. Wing markings well-developed with complete basal and distal branches in pterostigmal band.....
.....*N. daguanensis* **sp. nov.** (Yunnan)

Wing markings more or less reduced, pterostigmal band without branches **3**

3. T6 greatly humped at dorsal apex; epandrium with laterally projected posterolateral corners.....
..... *N. pendula* Qian & Zhou, 2001 (Yunnan)

T6 cylindrical; epandrium lacking projected posterolateral corners .....
..... *N. brisi* (Navás, 1930) (Guizhou, Sichuan, Yunnan)

4. Genital bulb broadly oval; notal organ not reaching mid-length of T4.....
.....*N. fangxianga* Zhou & Zhou, 2007 (Guizhou)

Genital bulb long ellipsoidal; notal organ greatly elongated, extending at least beyond T4.....
..... *N. kinnara* **sp. nov.** (Yunnan)

Discussion

Our examination of specimens revealed notable geographic variation in female wing markings in *N. kinnara* **sp. nov.**, particularly in the pterostigmal band of forewings. Specimens from Jizu and Ma'er Mountains (Binchuan and Heqing Counties) exhibit detached basal and apical branches. In contrast, individuals from Tianma Mountain (Eryuan County) display fully connected branches.

In contrast to females, males exhibit greater morphological stability across populations, with the exception of variation in notal organ length. Males from Jizu and Ma'er Mountains possess a distinctly elongated notal organ extending beyond T6, whereas those from Tianma Mountain have a shorter structure that extends past T4 but does not reach T6.

Despite notable variation in external morphology, genital structures remain stable across populations. To clarify possible divergence, integrative approaches—including molecular phylogenetics, behavioral analyses, and mating experiments—are required. In the absence of such data, we conservatively regard the populations from Jizu, Tianma, and Ma'er Mountains as a single species, *N. kinnara* **sp. nov.**

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Additional information

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